Photopyroelectric measurement of thermal diffusivity of solids based on the theory of thermal wave interferometry

ABSTRACT

A standard photopyroelectric configuration was used for the measurement of thermal diffusvity of solids by considering the phenomena of thermal wave interference. The thermal wave generated within the samples will be partially reflected and transmitted upon striking at the medium boundaries. The effect of infinite multiple reflection of the thermal wave within the samples was extensively discussed by Bennett and Patty in the generation of photoacoustic signal. In this work where sample surface heating was assumed and a thermally thick condition was applied, only one thermal wave reflection back into sample was considered, that is by the top pyroelectric coating, but with a series of transmitted wave into pyroelectric film from the upper and the lower pyroelectric-coating interface in the generation of photopyroelectric signal. A normalisation procedure was used to eliminate the number of unnecessary parameters needed to be known before one can determine the thermal diffusivity of the sample. With the appropriate sample-pyroelectric detector dimension, the thermal diffusivity of any solid sample is readily being determined. The method was experimentally tested for aluminum, copper, and nickel, and the values obtained were close to the literature values.

Keyword: Photopyroelectric; Thermal diffusvity of solids; Thermal wave interferometry